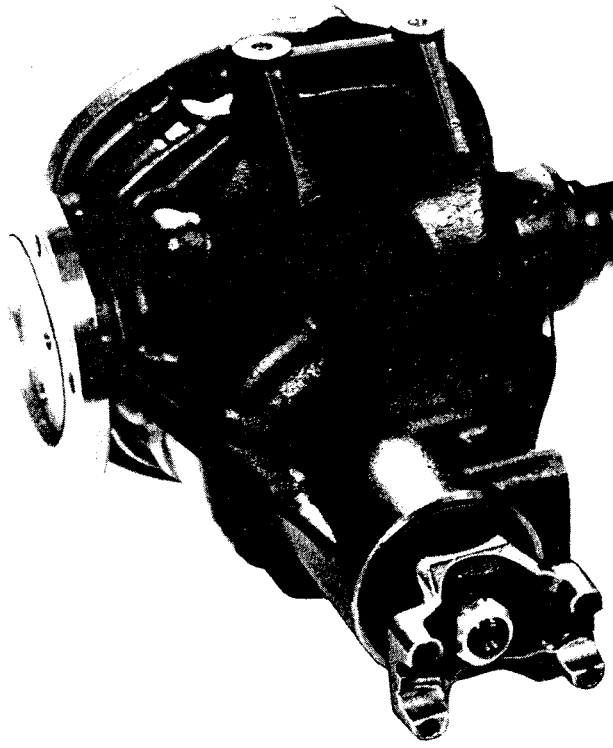
SPICER AXLE

SERVICE MANUAL

MODEL 30



FRONT CARRIER TYPE

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IMPORTANT SAFETY NOTICE

PROPER SERVICE AND REPAIR IS IMPORTANT TO THE SAFE, RELIABLE OPERATION OF ALL MOTOR VEHICLES OR DRIVING AXLES WHETHER THEY BE FRONT OR REAR. THE SERVICE PROCEDURES RECOMMENDED AND DESCRIBED IN THIS SERVICE MANUAL ARE EFFECTIVE METHODS FOR PERFORMING SERVICE OPERATIONS. SOME OF THESE SERVICE OPERATIONS REQUIRE THE USE OF TOOLS SPECIALLY DESIGNED FOR THE PURPOSE. THE SPECIAL TOOL SHOULD BE USED WHEN AND AS RECOMMENDED.

IT IS IMPOSSIBLE TO KNOW, EVALUATE, AND ADVISE THE SERVICE TRADE OF ALL CONCEIVABLE WAYS IN WHICH SERVICE MIGHT BE DONE OR OF THE POSSIBLE HAZARDOUS CONSEQUENCES OF EACH WAY.

ACCORDINGLY, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED MUST FIRST SATISFY HIMSELF THOROUGHLY THAT NEITHER HIS SAFETY NOR VEHICLE SAFETY WILL BE JEOPARDIZED BY THE SERVICE METHODS HE SELECTS.

SHOULD AN AXLE ASSEMBLY REQUIRE COMPONENT PARTS REPLACEMENT, IT IS RECOMMENDED THAT "ORIGINAL EQUIPMENT" REPLACEMENT PARTS BE USED. THEY MAY BE OBTAINED THROUGH YOUR LOCAL SERVICE DEALER OR OTHER ORIGINAL EQUIPMENT MANUFACTURER PARTS SUPPLIER. THE USE OF NON-ORIGINAL EQUIPMENT REPLACEMENT PARTS IS NOT RECOMMENDED AS THEIR USE MAY CAUSE UNIT FAILURE AND/OR EFFECT VEHICLE SAFETY.

NOTE

Throughout this manual, reference is made to certain tool numbers whenever special tools are required. These numbers are numbers of Miller Special Tools, 32615 Park Lane, Garden City, Michigan 48135. They are used herein for customer convenience only. Dana makes no warranty or representation to these tools.

LUBRICATION

It is not our intent to recommend any particular brand or make of lubricant for the Spicer hypoid axles. However, a S.A.E. 90 weight multipurpose gear lubricant meeting Mil. Spec. L-2105-B, or 80 W 90 multipurpose gear lubricant meeting Mil. Spec. L-2105-C, and suitable for A.P.I. Service Classification GL-5 is suggested as a mimimum requirement.

SHAFT BEARING LUBRICATION

Shaft bearings are lubricated with the hypoid gear lube in the housing. To eliminate any risk of damage prior to gear lube circulation reaching the shaft bearings, they must be packed with grease. For grease packing it is recommended that a number 2 consistency, lithium base, 12 Hydroxy Stearate Grease containing an E.P. additive be used.

COLD WEATHER OPERATION

If the vehicle is operated below 0° F (-18° C), it is advisable to use S.A.E. 80 Multi-Purpose Gear Lubricant meeting Mil. Spec. L-2105-B, and suitable for A.P.I. Service Classification GL-5.

SUBMERSION OR DEEP WATER FORDING

In the event the gear carrier housing should become submerged in water, particularly if over the breathers, it is recommended that the hypoid gear lubricant be drained daily and internal parts be inspected for water damage and/or contamination.

Clean, examine, and if necessary, replace damaged parts, prior to assembling and refilling with the specified hypoid lubricant.

NOTE

It is recommended that whenever bearings are removed they are to be replaced with new ones regardless of mileage.

SPECIAL SERVICE TOOLS

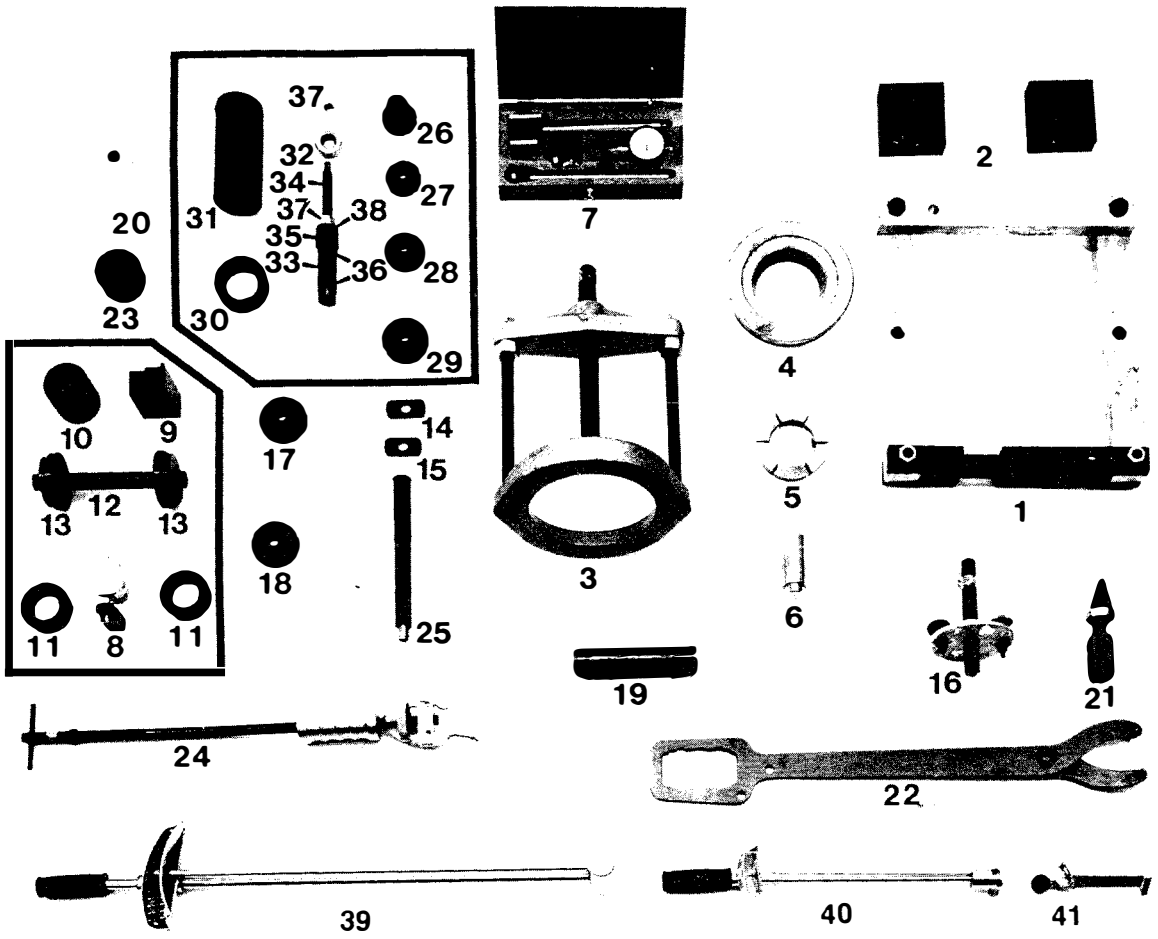


Figure 2 1021-2

The following is a detailed list of all special tools required to service the Spicer Model 30 Axle Housing and Shaft Assembly.

Item No.	Tool No.	Description
1	D-113	Spreader
2	D-263-1	Adapter Blocks w/Hold-Down Screws
3	DD-914-P	Press
4	DD-914-9	Adapter Ring
5	C-293-39	Adapter Set - Differential and Inner Pinion Bearing Cones
6	SP-3289	Adapter Plug—Differential Hub
7	D-128	Indicator Set
*8	D-115	Scooter Gage
*9	D-115-1	Pinion Height Block
*10	D-138	Master Pinion Block
*11	D-134	Master Bearing—Differential
*12	D-115-3	Arbor
*13	D-115-4	Arbor Disc
14	D-147	Remover—Front Pinion Bearing Cup
15	D-149	Remover—Rear Pinion Bearing Cup
16	C-452	Remover—Yoke
17	D-144	Installer—Front Pinion Bearing Cup
18	D-146	Installer—Rear Pinion Bearing Cup
19	W-262	Installer—Rear Pinion Bearing
20	W-147-D	Installer—Pinion Oil Seal
21	W-162	Installer—Yoke
22	C-3281	Holder—Yoke
23	C-3716-A	Installer—Differential Side Bearings

Item No.	Tool No.	Description
24	D-131	Slide Hammer
25	C-4171	Handle—Universal
**26	D-266	Installer—Shaft Bearing—In Tube
**27	D-267	Installer—Shaft Seal—In tube
**28	D-268	Installer—Shaft Bearing—In Housing
**29	D-269	Installer—Shaft Seal—In Housing
**30	D-270-1	Adapter Ring
**31	L-4518-1	Receiver
**32	L-4454-8	Thrust Bearing
**33	L-4454-9	Main Body
**34	L-4454-10	Screw
**35	L-4454-11	Cup—Main Body
**36	L-4454-12	"O" Ring
**37	L-4454-13	Hex Nut (1/2—20)
**38	L-4454-14	Washer
39	C-4053	Torque Wrench—300 Lbs.-Ft.
40	C-3952A	Torque Wrench—150 Lbs.-Ft.
41	D-193	Torque Wrench—50 Lbs.-Ft.

*Pinion Setting Gauge and Master Differential Bearing Kit No. D-115-30

**Axle Shaft Bearing and Seal Removal and Installation Kit No. D-30-AM

NOTE

Torque wrenches C-4053, C-3952A, and D-193 are optional and can be purchased separately. These torque wrenches are not included in the axle tool kits.

AXLE IDENTIFICATION

All Dana axles are identified with a complete part number and the manufacturing date stamped on the axle tube in ⅛" high (3.17mm) characters. A typical identification number would be 610078-8, 12 107A and is interpreted as follows: the seven digit dash number is the Dana part number for the complete axle. The next three numbers are the build date (month, day, year), the next number is the assembly line that built the axle, the first letter is the work shift, second letter is the manufacturing facility. For example: December 1, 1980, Line 7, First Shift.

It is recommended that when referring to the axle, obtain the complete part number and build date. To do this, it may be necessary to wipe or scrape off dirt, etc. from the axle tube.

There is also an axle gear ratio tag location on the right side of the cover plate and held in place with two of the cover plate screws. This tag gives the tooth combination of the ring gear and pinion, the total gear ratio, and also the customer part number.

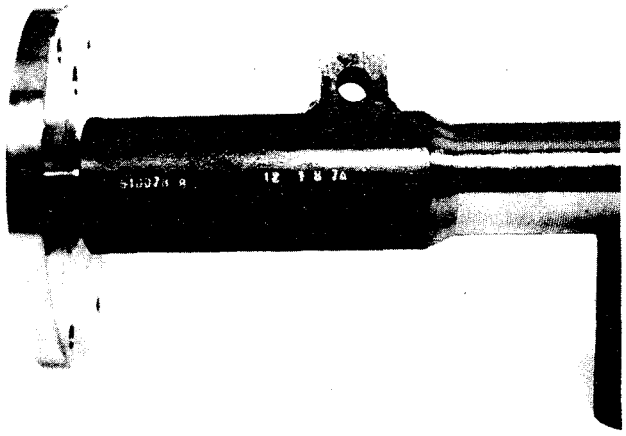


Figure 3 1021-3

NOTE

All maintenance and service require removal of the cover plate and axle shafts.

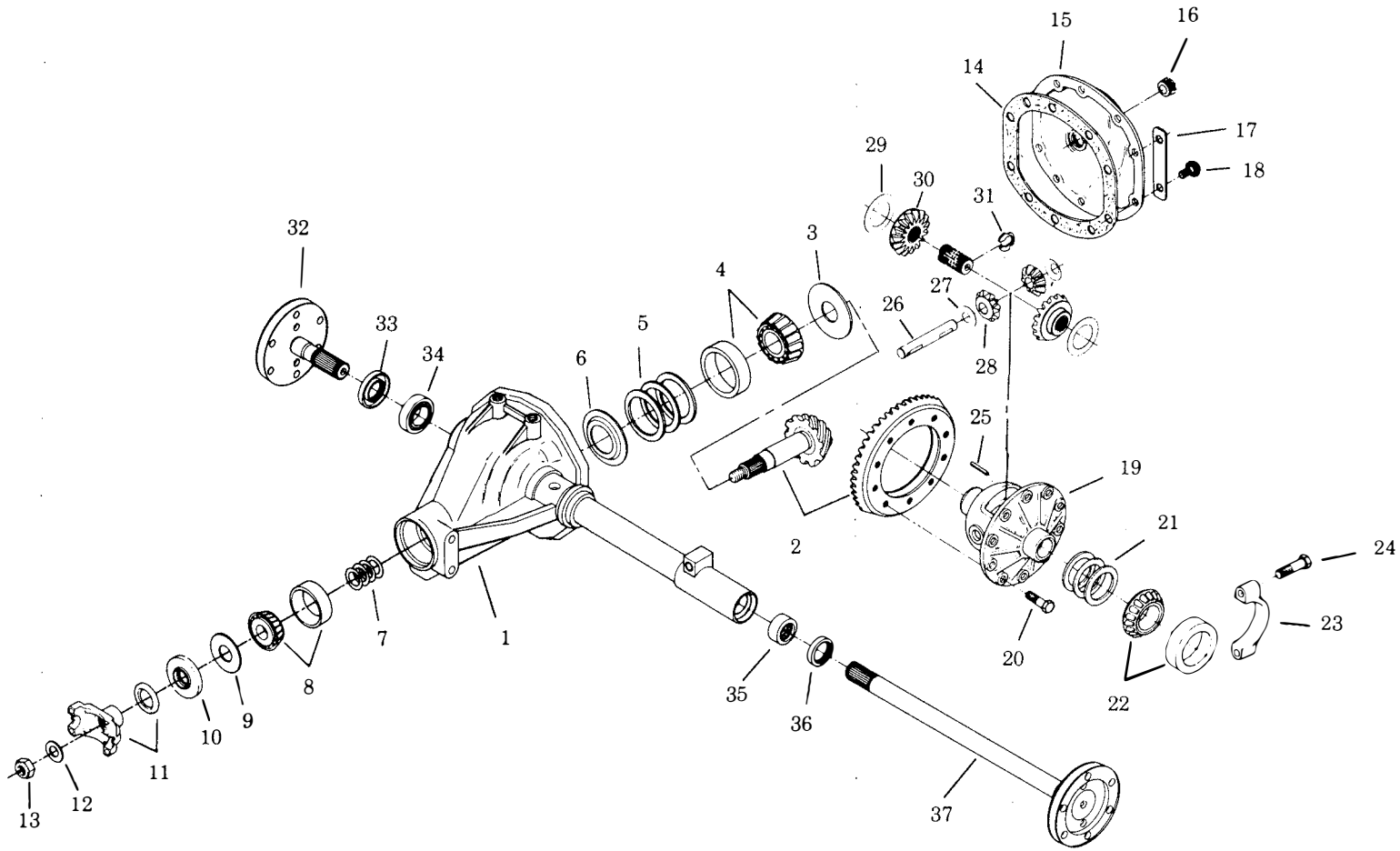
Where vehicle installation restricts cover plate removal,refer to vehicle manufacturer's recommendations to remove the entire axle housing and shaft assembly from the vehicle.

The procedures described here will consider the axle housing and shaft assembly removed.

CAUTION

Do not apply vehicle weight to wheels without half-shafts in place and fasteners properly torqued.

Half-shaft to axle shaft flange bolt torque is 45 lbs.-ft. (61N•m).



1 — Axle Housing
2 — Drive Gear Set
3 — Oil Slinger (Inner)
4 — Pinion Bearing (Inner)
5 — Pinion Position Shims
6 — Oil Baffel
7 — Pinion Bearing Preload Shims
8 — Pinion Bearing (Outer)
9 — Oil slinger (Outer)
10 — Oil Seal
11 — End Yoke Assembly
12 — Washer
13 — Nut
14 — Cover Gasket
15 — Carrier Cover
16 — Fill Plug
17 — Identification Tag
18 — Cover Screw (10)
19 — Differential Case
20 — Drive Gear Screw (10)
21 — Differential Bearing Shims
22 — Differential Bearing
23 — Differential Bearing Cap
24 — Differential Bearing Cap Screw
25 — Differential Cross Shaft Lock Pin
26 — Cross Shaft
27 — Differential Pinion Thrust Washer
28 — Differential Pinion
29 — Differential Side Gear Thrust Washer
30 — Differential Side Gear
31 — Axle Shaft Snap Ring
32 — Axle Shaft (L.H.)
33 — Axle Shaft Seal (L.H.)
34 — Axle Shaft Bearing (L.H.)
35 — Axle Shaft Bearing (R.H.)
36 — Axle Shaft Seal (R.H.)
37 — Axle Shaft (R.H.)

Figure 4

1021-4

Loosen cover plate screws and allow lube to drain out.

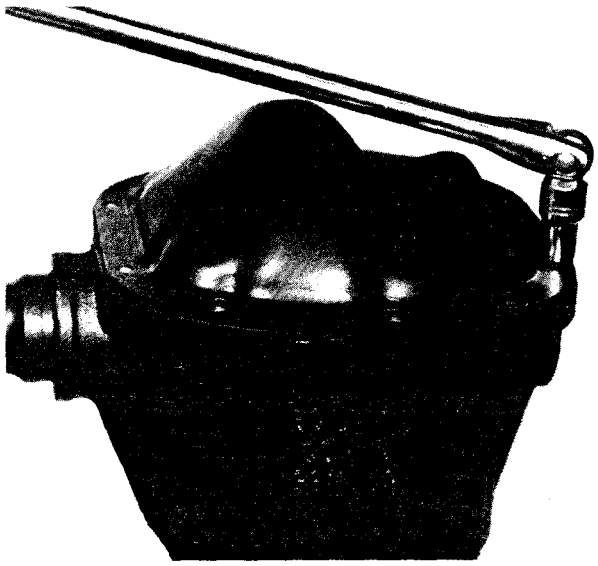


Figure 5 1021-5

Remove cover plate screws, cover plate, and gasket (discard old gasket). Tip carrier to allow lube to drain completely.

Place assembly on work bench and secure it by clamping the axle tube in a vise.

At this time, clean the cover face of the carrier, making sure it is free from nicks and any particles left by the old gasket. Remove RTV from two ½" diameter manufacturing holes.

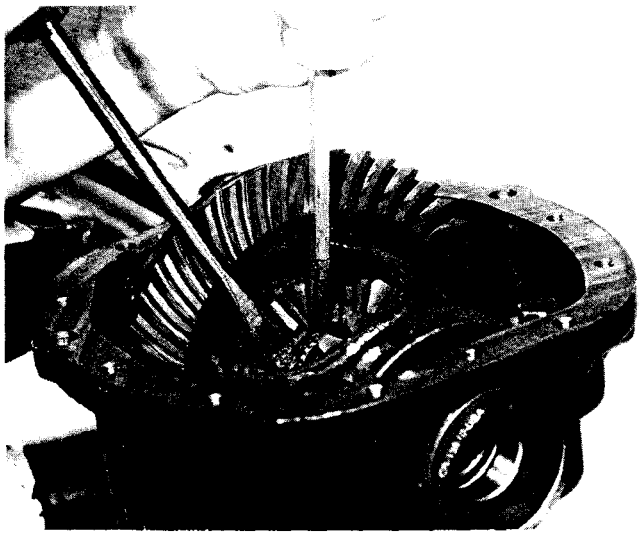


Figure 6 1021-6

Remove axle shaft snap rings by rotating the shaft so that the open side of the snap ring is exposed, hold one side of the snap ring firmly with a screw driver, while pushing on the other side, as shown.

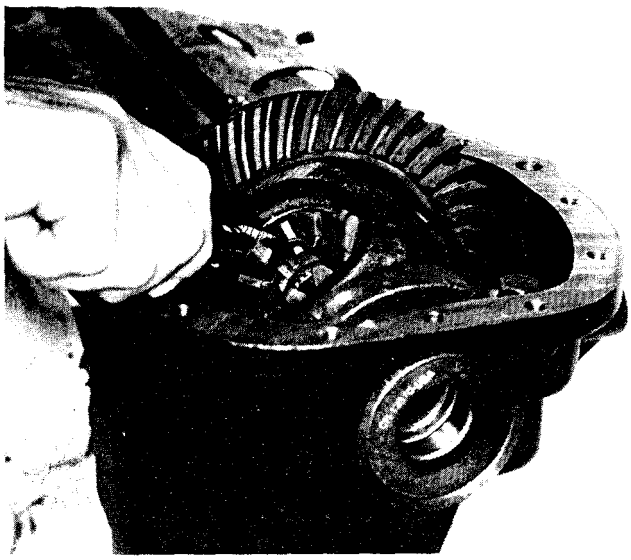


Figure 7 1021-7

Slide it from the grove expanding it far enough so that by rotating the shaft 180°, the snap ring can be pulled off with a pair of pliers or pryed out with a large screw driver.

CAUTION

Eye protection should be worn when removing or installing the snap rings.

Inspect the snap ring to be certain it is not broken. Retrieve any broken pieces from the housing before proceeding.

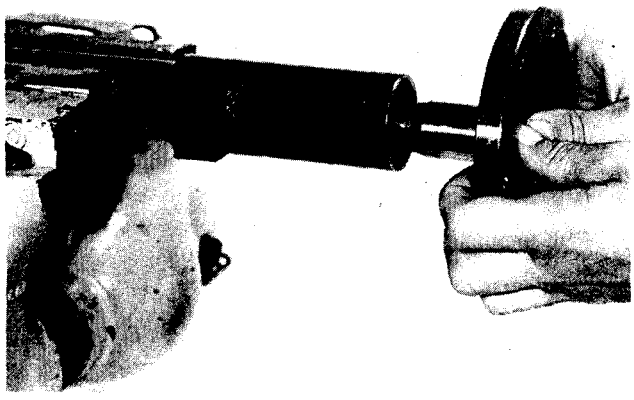


Figure 8 1021-8

Remove the axle shafts.

SERVICE PROCEDURES
SHAFT BEARINGS AND SEALS

DISASSEMBLY

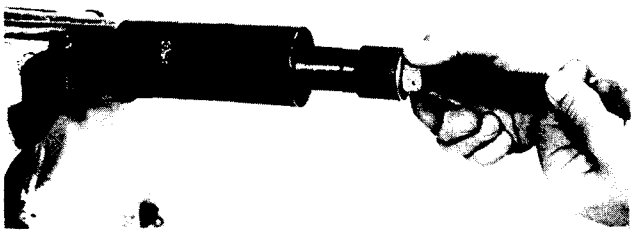


Figure 9 1021-9

Insert the puller through the axle shaft seal and bearing and position it to a depth that will allow the flange on the ends of the main body to expand into the relief behind the needle bearing. Expand the puller by holding the nut and turn the screw until the puller centers itself.

Tools—L-4454-9 Mainbody, L-4454-10 Screw, L-4454-11 Cup, L-4454-12 "O" Ring, L-4454-13 Hex Nut (½-20) and L-4454-14 Washer.

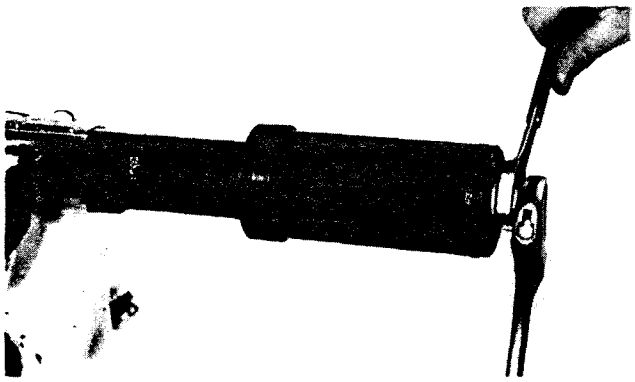


Figure 10 1021-10

Place adapter ring and receiver over the puller as shown, install the nut on the screw and draw the bearing and seal into the receiver by holding the screw and turning the nut.

Tools—D-270-1 Adapter Ring, L-4518-1 Receiver, L-4454-13 Nut, L-4454-14 Washer,

Discard seal and bearing and replace with new one at time of assembly.

Figure 11 1021-11

Using the procedure and tools described for FIGURE 9, install the puller on the L.H. shaft bearing.

Figure 12 1021-12

Place the receiver over the puller (adapter ring is not required) and install the thrust bearing and nut. Draw the bearing and seal from the housing.

Tools L-4518-1 Receiver, L-4454-8 Thrust Bearing, L-4454-13 Nut.

Discard seal and bearing and replace with new one at time of assembly.

NOTE

It is recommended that whenever bearings are removed, they are (regardless of mileage) replaced with new ones.

SERVICE PROCEDURES

ASSEMBLY — SHAFT BEARINGS AND SEALS

Figure 13 1021-13

Assemble new L.H. shaft bearing. (Seat bearing against shoulder.)

Tools—D-268 Installer, C-4171 Handle.

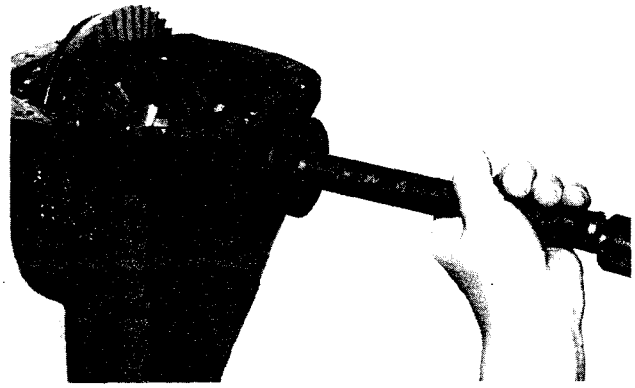


Figure 14 1021-14

Assemble new L.H. shaft seal. (Seat seal against bearing.)

Tools—D-269 Installer, C-4171 Handle.

Figure 15 1021-15

Assemble new R.H. shaft bearing. (Tool controls bearing installation depth.)

Tools—D-266 Installer, C-4171 Handle.

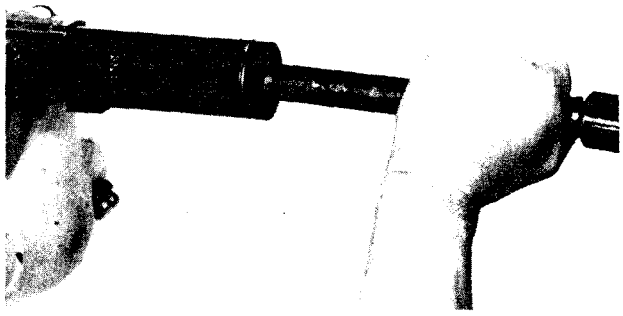


Figure 16 1021-16

Assemble new R.H. shaft seal. (Seat seal against shoulder.)

Tools—D-267 Installer, C-4171 Handle.

CARRIER SECTION

DISASSEMBLY

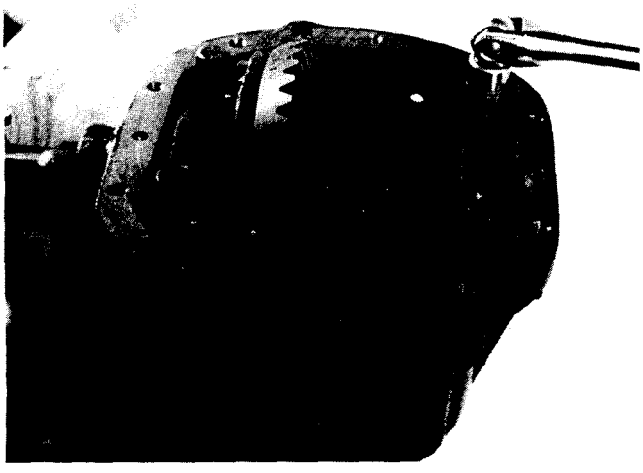


Figure 17 1021-17

With carrier positioned as shown and secured in a vise, remove bearing caps. Note mating letters stamped on caps and carrier. This is important at time of assembly as they are to be assembled exactly as removed. Letters or numbers should correspond in both the horizontal and vertical position.

NOTE

Axle shafts must be removed for service procedures involving removal of the differential.

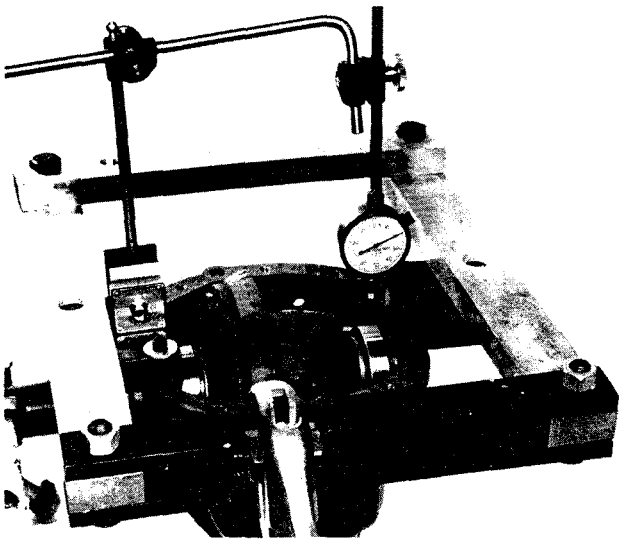


Figure 18 1021-18

Mount spreader with adapter blocks and holddown screws to carrier as shown. **Do not spread carrier over .020″ (.50mm).** Use dial indicator as shown.

After carrier has been spread, remove indicator.

Tools—D-113 Spreader, D-263-1 Adapter Blocks.

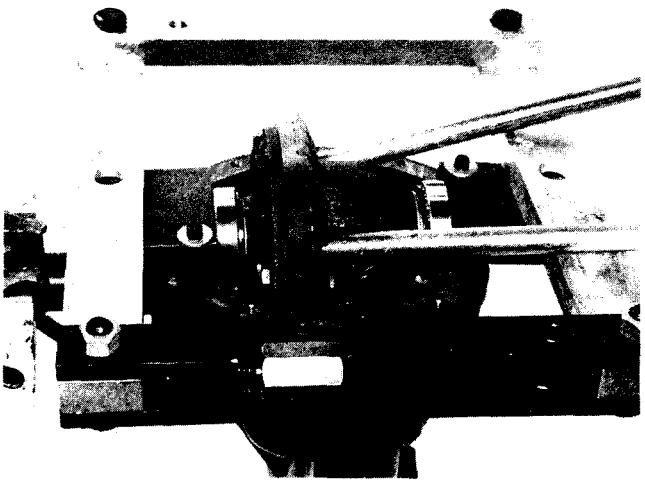


Figure 19 1021-19

Pry differential case from carrier with two pry bars as shown. After **differential case has been removed, remove spreader.** Use caution to avoid damage to ring gear and pinion. Mark or tag the bearing cups indicating from which side they were removed.

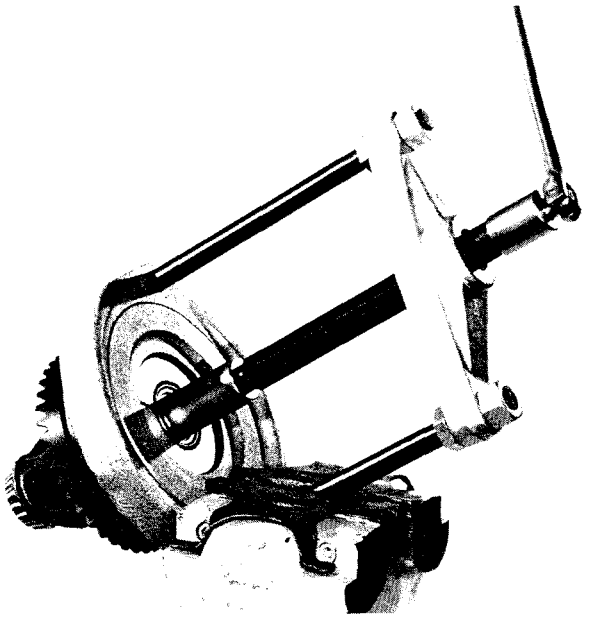


Figure 20 1021-20

Remove differential bearings with a puller as shown. Wire shims, bearing cup and bearing cone together. Identify from which side they were removed (ring gear side or opposite side.) If shims are mutilated replace with new shims at the time of assembly. Shims are available in thicknesses of .003″, .005″, .010″, and .030″ (mm .08, .13, .25 and .76).

Tools—DD-914-P Press, DD-914-9 Adapter Ring, SP-3289 Plug, C-293-39 Adapter Set.

NOTE

It is recommended that whenever bearings are removed, they are (regardless of mileage) replaced with new ones.

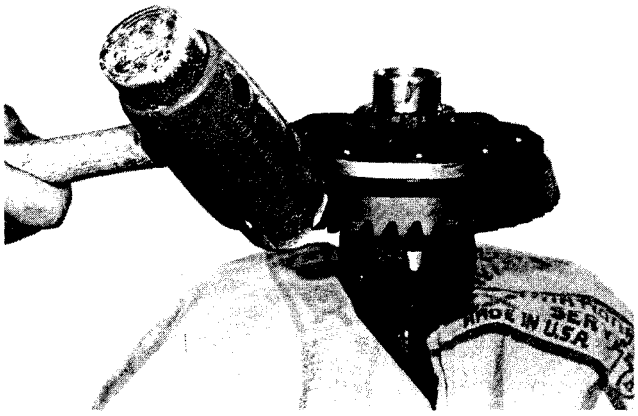


Figure 21 1021-21

Place a few shop towels over the vise to prevent the ring gear teeth from being nicked after it is free from the case.

Place case in vise. Remove ring gear screws. Tap ring gear with rawhide hammer to free it from the case. Remove case and ring gear from vise.

NOTE

It is recommended that whenever the ring gear screws are removed, they are replaced with new ones.

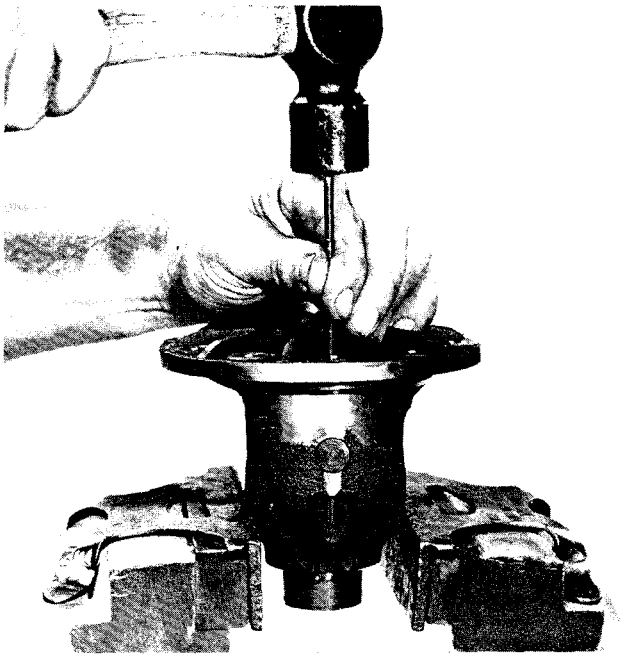


Figure 22 1021-22

Replace case in vise and drive out lock pin which secures the pinion mate shaft. Use a small drift as shown.

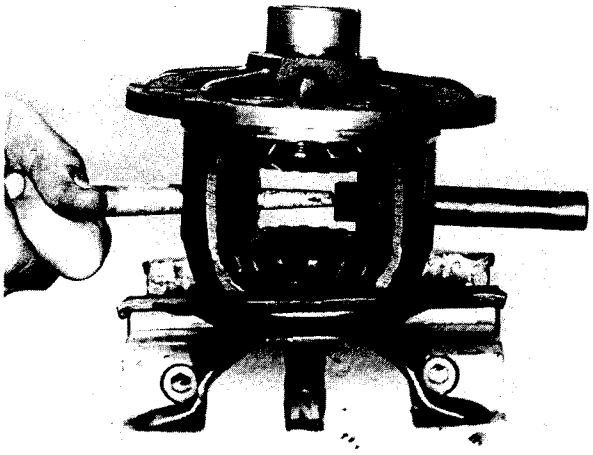


Figure 23 1021-23

Remove pinion mate shaft with drift as shown.

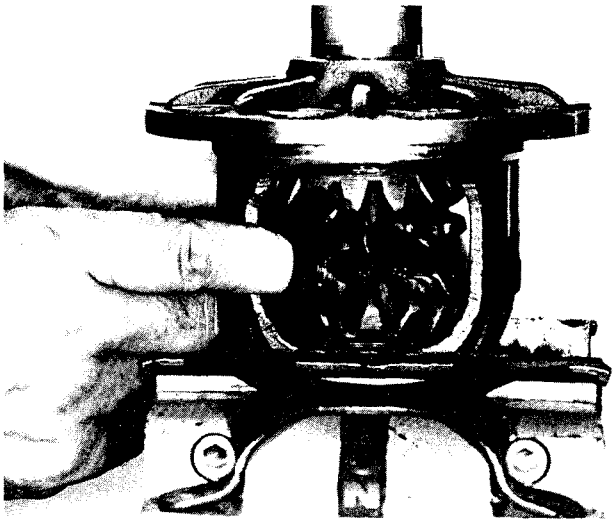


Figure 24 1021-24

To remove side gears and pinion mate gears, rotate the side gears. This will allow the pinion mate gears to turn to the opening of the case. Remove pinion mate gears and also the spherical washers behind the gears. Lift out gears and thrust washers. Inspect all parts, including the machined surfaces of the case itself. Where necessary replace all worn parts. If excessive wear is visible on all parts, it is suggested that the complete differential assembly be replaced. If any one of the gears are to be replaced, they are to be replaced as a set.

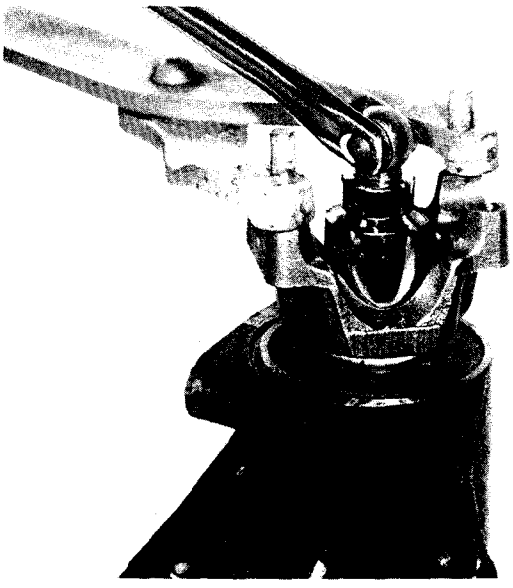


Figure 25 1021-25

Turn nose of carrier in a vertical position to remove pinion nut. Hold end yoke with tool as shown, and remove pinion nut and washer.

Tool—C-3281 Holding Wrench.

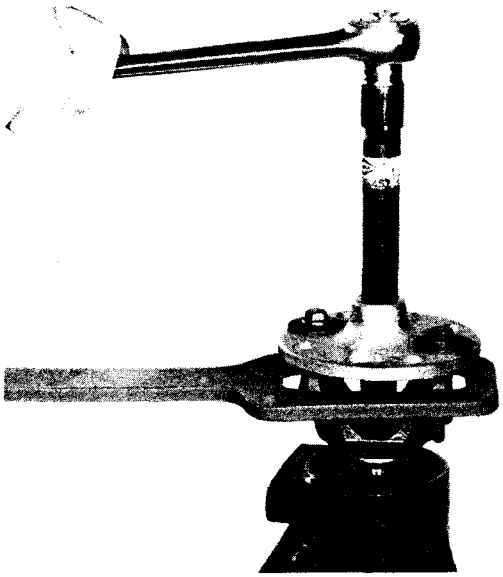


Figure 26 1021-26

Remove end yoke with tools as shown. If yoke shows wear in the area of the seal contact, it should be replaced.

Tools—C-452 Remover - Yoke, C-3281 Holding Wrench.

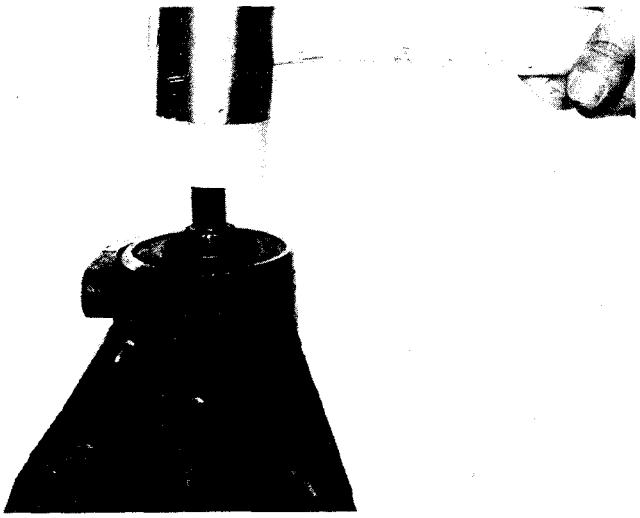


Figure 27 1021-27

Remove pinion by tapping with a rawhide hammer. Catch the pinion with your hand to prevent it from falling to the ground and being damaged.

NOTE

On the spline end of the pinion, there are bearing preload shims. These shims may stick to the bearing or the pinion or even fall out. The shims are to be collected and kept together since they will be used later in assembly. Try not to mutilate shims. If shims are mutilated, replace with new ones. Shims are available in thicknesses of .003", .005", .010", and .030" (mm.8, .13, .25 and .76).

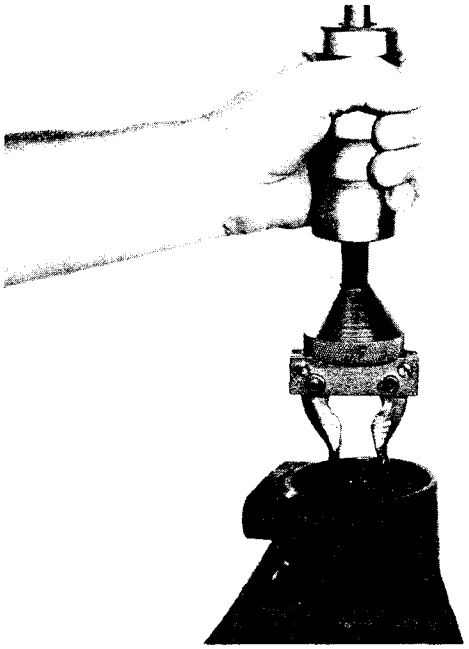


Figure 28 1021-28

Pull out pinion seal with puller as shown. Discard seal. Replace with new seal at time of assembly. Remove bearing cone and outer pinion oil slinger.

Tools—D-131 Slide Hammer.

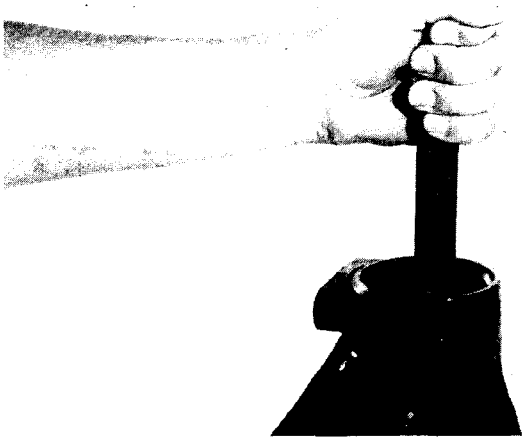


Figure 29 1021-29

Remove the inner bearing cup with tools as shown.

Tools—D-149 Remover, C-4171 Handle.

NOTE

An oil baffle and pinion position shims are located between the bearing cup and carrier bore. The baffle will be damaged when removing the bearing cup and must be replaced at time of assembly. If shims are bent or nicked, they should be replaced at time of assembly. Wire the shim stack together (including the baffle) and measure each. If stack has to be replaced, replace with the same thickness.

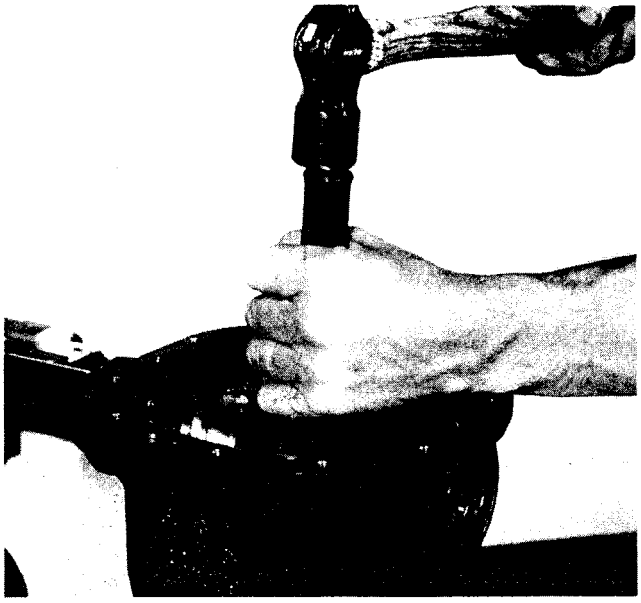


Figure 30 1021-30

Turn nose of carrier down. Remove outer pinion bearing cup as shown. Locate driver on back edge of cup, drive cup out of carrier. CAUTION: Do not nick carrier bore.

Tools—D-147 Remover, C-4171 Handle.

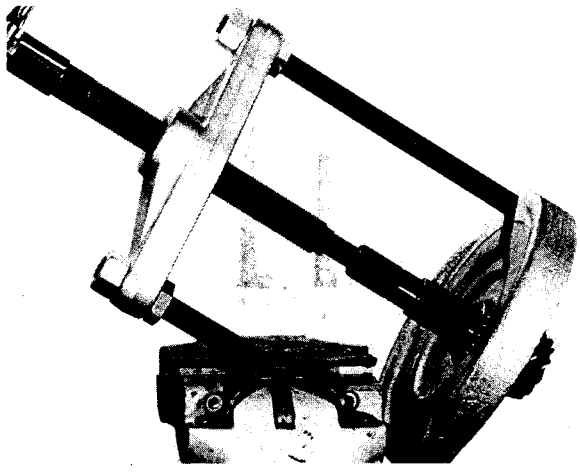


Figure 31 1021-31

Remove inner pinion bearing with tools as shown.

Tools—DD-914-P Press, DD-914-9 Adapter Ring, C-293-39 Adapter Set.

NOTE

The oil slinger located between the bearing cone and the pinion head affects pinion position and must be kept intact for assembly.

ASSEMBLY — CARRIER SECTION

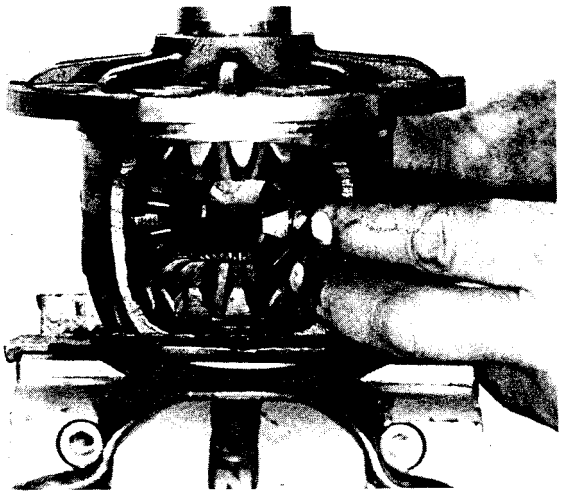


Figure 32 1021-32

Place differential case in vise as shown. Apply grease to new side gear thrust washers and hubs of side gear. Assemble both side gears. Apply grease to new pinion mate spherical washers and the pinion mate gears. Assemble pinion mate gears. An easy way to assemble the side gears and pinion mate gears is to have all parts lubricated before assembly. Assemble both side gears and thrust washers, hold them in place with hand, then assemble the pinion gears to hold the side gears in place.

Rotate the side gears until the holes of the washers and pinion gears line up with the holes of the case. If the gears cannot be rotated by hand, install one of the axle shafts into the side gear spline and use a pipe wrench to turn the shaft.

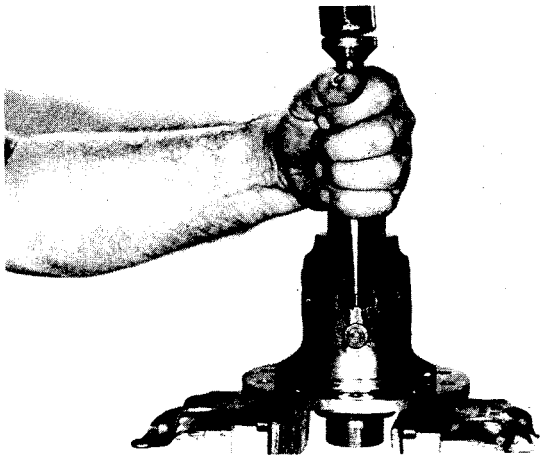


Figure 33 1021-33

Install pinion mate shaft. Assemble lock pin. Peen metal of case over pin to lock in place.

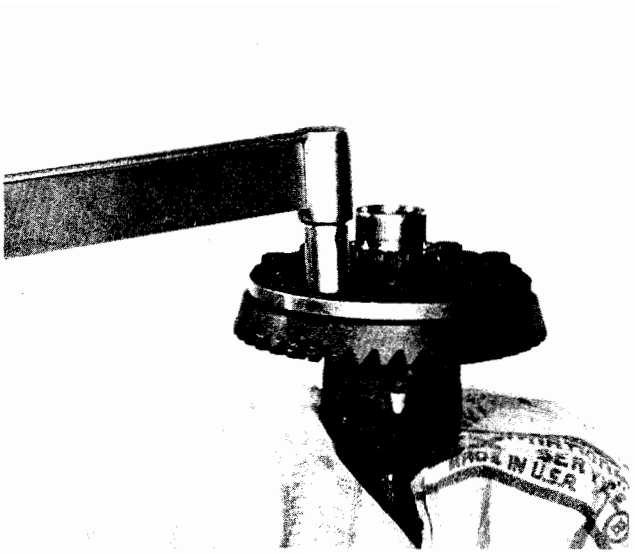


Figure 34 1021-34

Be sure flange face of the case is free of nicks or burrs. Assemble ring gear to case using new ring gear screws. Draw up screws alternately and evenly.

Torque screws to 45-60 lbs. ft. (61.0—81.3 N•m).

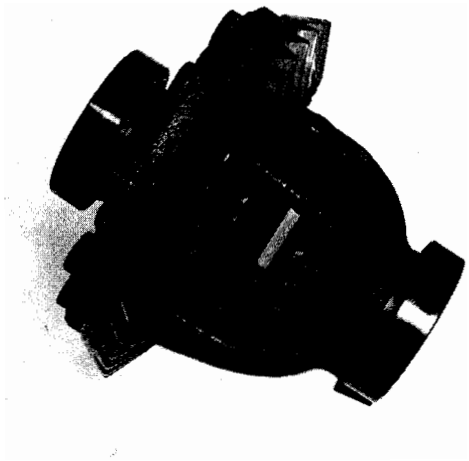


Figure 35 1021-35

Remove all nicks, burrs, dirt, etc. from differential case bearing hubs to allow master bearings to rotate freely.

Install master differential bearing onto case.

Tools—Master Bearings D-134.

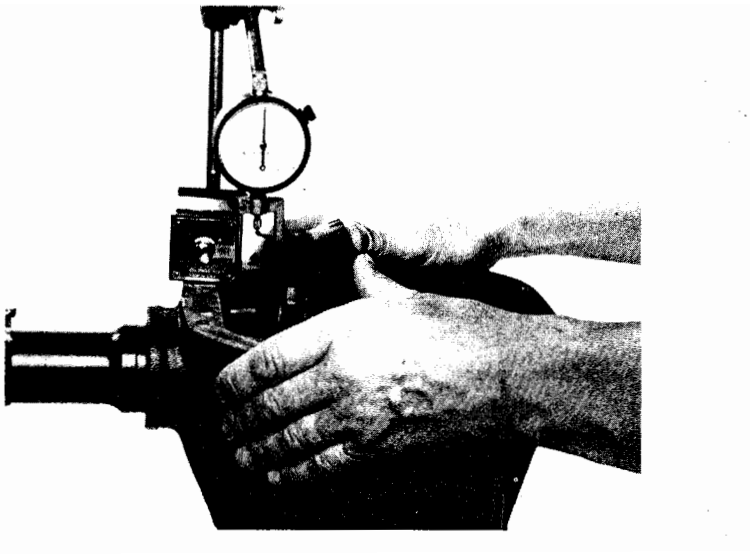


Figure 36 1021-36

Assemble differential case into carrier (less pinion). Mount dial indicator, with a magnetic base as shown. Locate tip of indicator on flat surface of one of the gear screws. Mark screw with a piece of chalk. Force the differential assembly as far as possible in the direction towards the indicator. With force still applied, set indicator at zero. (0).

Tool—Indicator D-128.

NOTE

Indicator should have a minimum of .200″ (5.08mm) travel.

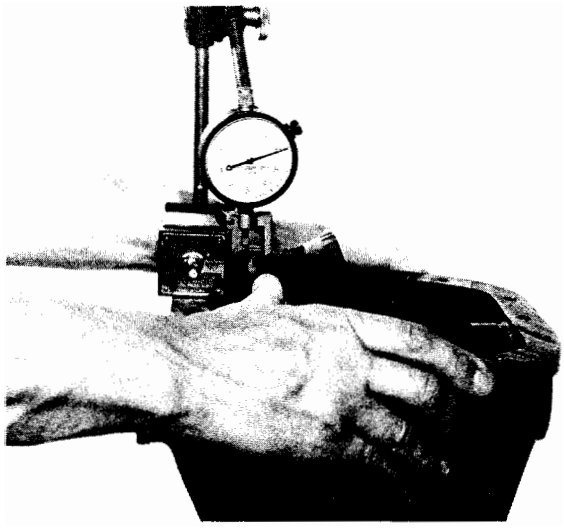


Figure 37 1021-37

Force the differential assembly as far as it will go in the opposite direction. Repeat these steps until the same reading is obtained.

Record the reading of the indicator.

This will be the total amount of shims required (less preload) and will be calculated later during assembly.

After making sure the readings are correct, remove indicator and differential assembly from housing. **Do not remove master bearings from differential case at this time.**

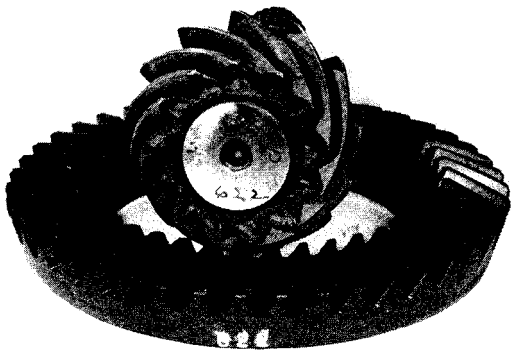


Figure 38 1021-38

View of ring and pinion set.

Ring gears and pinions are supplied in matched sets only. Matching numbers on both the pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring before proceeding with assembly.

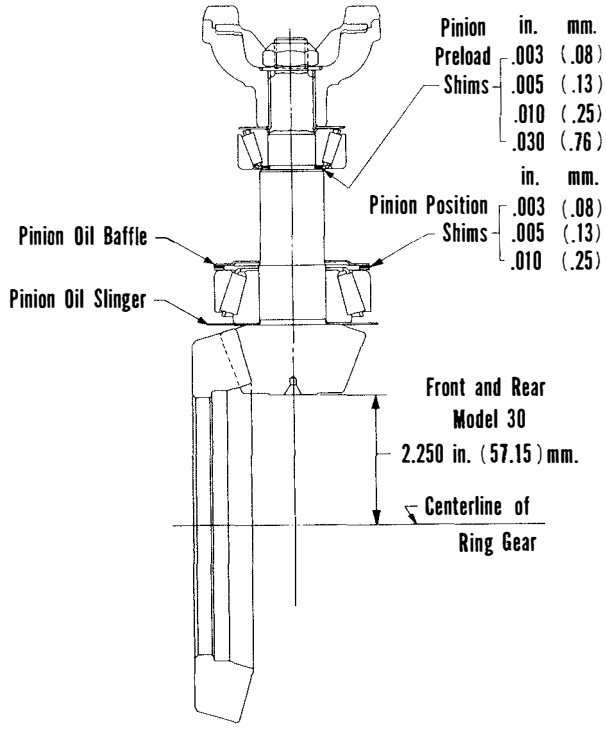


Figure 39 1021-39

The distance from the centerline of the ring gear to the button end of the pinion for the Model 30 axle is 2.250 inches (63.5 mm).

On the button end of each pinion there is etched a plus (+) number, a minus (-) number, or a zero (0), which indicates the best running position for each particular gear set. This dimension is controlled by the shim pack which includes the baffle behind the inner bearing cup, and the oil slinger between the bearing cone and the pinion head.

For example: if a pinion is etched +3 (m + 8), this pinion would require the .003" (.08mm) less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased to 2.253" (57.2mm), which is just what a +3 (m + 8) indicates. Or if a pinion is etched -3 (m-8), we would want to add .003" (.08mm) more shims than would be required if the pinion were etched "0". By adding .003" (.08mm) shims the mounting distance of the pinion was decreased to 2.247" (57 .1mm) which is just what a -3 (m - 8) etching indicated.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this same dimension. The baffle is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005", and .010" (mm .08, .13 and .25).

NOTE

If baffle or slinger is bent or mutilated, it should be replaced.

Measure the baffle, the slinger and each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the (+) or (-) etching on both the old and new pinion and adjust the thickness of the new shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads +2 (m + 5) and the new pinion is -2 (m - 5), add .004" (.10mm) shims to the original shim pack.

Old Pinion Marking	New Pinion Marking								
	-4	-3	-2	-1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
0	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
-1	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
-2	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
-3	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
-4	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

Figure 40 1021-40

Use pinion setting chart shown as a guide to set pinion position.

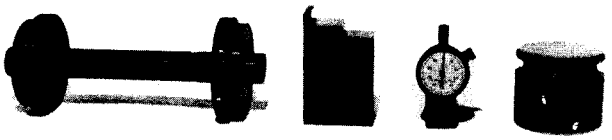


Figure 41 1021-41

View of cross arbor and arbor discs, height block, scooter gage, and master pinion block.

NOTE

Cross arbor and master bearing discs can be used on both the Model 30 and Model 44 axles. Use small diameter discs for Model 30 axles.

NOTE

Be sure that all carrier bores are free from all nicks, dirt or any other contamination.

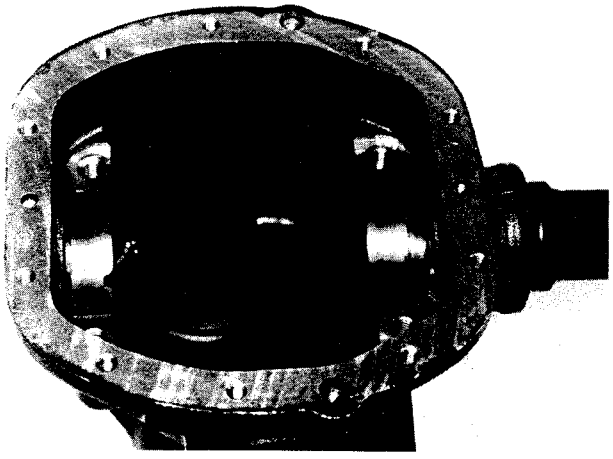


Figure 42 1021-42

Place the master pinion block into the pinion bore of the carrier as shown.

Tool—Master Pinion Block D-138.

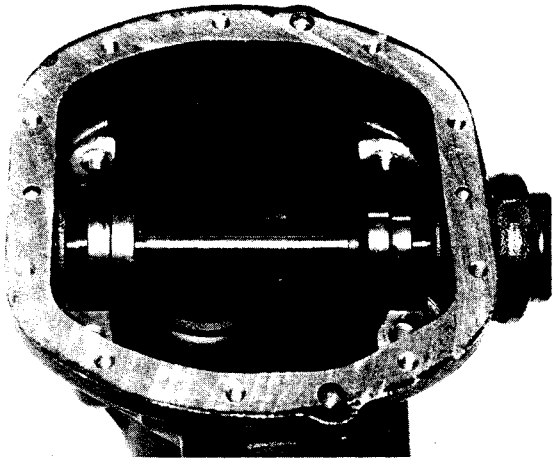


Figure 43 1021-43

Place arbor discs and arbor into cross bores of the carrier as shown.

Tools—Arbor D-115-3, Arbor Discs D-115-4.

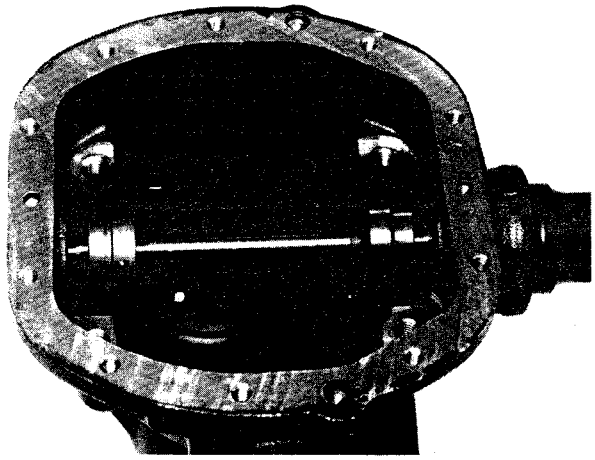


Figure 44 1021-44

Place pinion height block on top of master pinion block, and against arbor as shown.

Tools—Pinion Height Block 115-1.

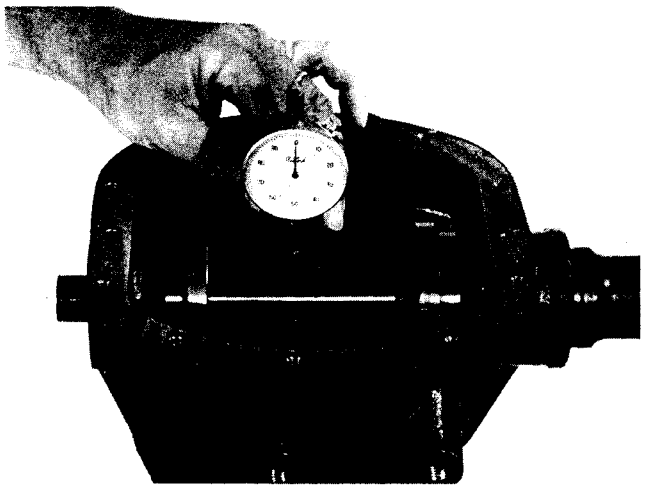


Figure 45 1021-45

Place scooter gage on small step of pinion

height block. Apply pressure with fingers making sure the gage is flat on the pinion height block, while pressure is applied, set indicator at zero "0".

Tool—Scooter Gage D-115.

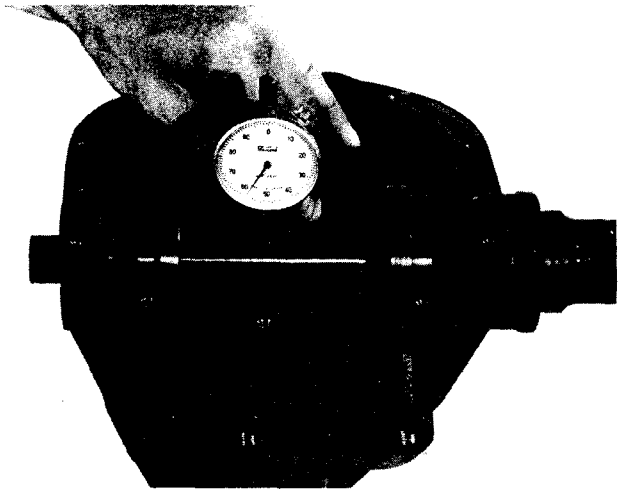


Figure 46 1021-46

Slide scooter gage over arbor. As gage slides over top of arbor, it will travel in a clockwise direction. When indicator is on center of arbor (on top) it will stop travelling in a clockwise direction. If indicator starts to travel in a counterclockwise direction, this means that you have passed the center (top) of the arbor. Record only the reading when the indicator is at the highest point. This reading indicates the amount of shims necessary to obtain the correct shim pack, plus (+) or minus (-) the etching on the button end of the pinion. If the etching is zero (0) the shim pack will remain unchanged.

For example: If a pinion is etched +3 (m + 8), this pinion would require .003" (.08mm) less shims than a pinion etched zero "0".

If a pinion is etched-3 (m - 8), we would want to add .003" (.08mm) more shims than would be required if the pinion were etched zero "0".

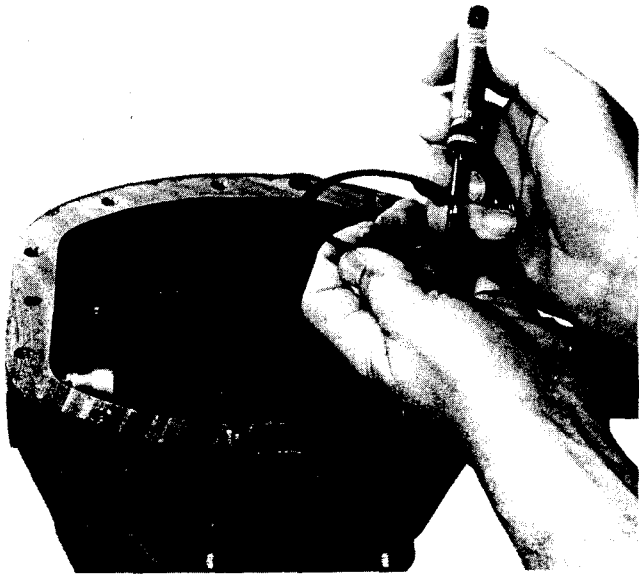


Figure 47 1021-47

Measure each shim separately with a micrometer and add together to get total shim pack thickness. The baffle and the slinger are to be measured and included as a part of the total shim pack.

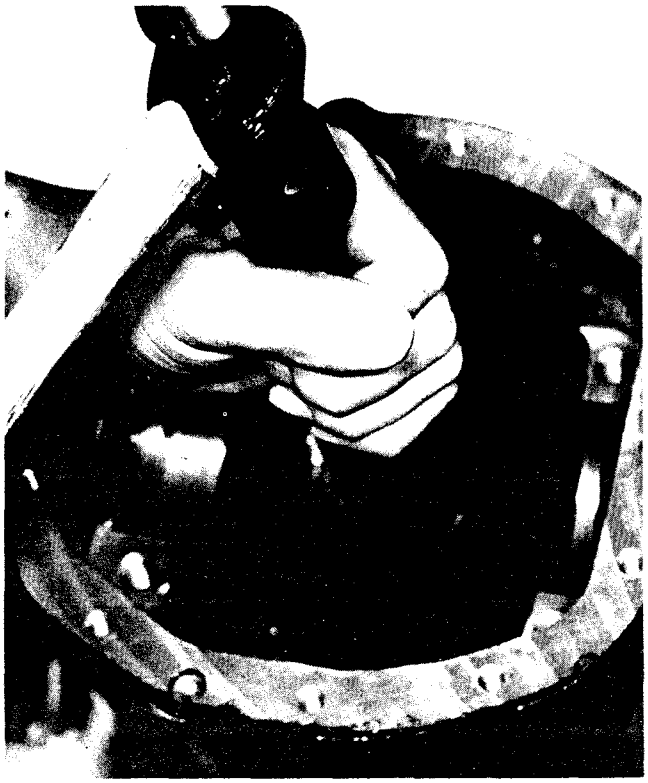


Figure 48 1021-48

Place the baffle and the required amount of shims in the inner bearing bore, drive the inner bearing cup into carrier with tools as shown.

Tools—D-146 Cup Installer, C-4171 Handle.

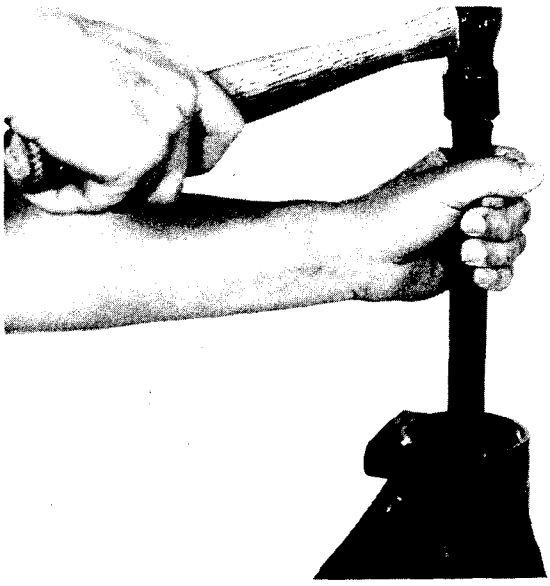


Figure 49 1021-49

Assemble the outer pinion bearing cup into carrier as shown.

Tools—D-144 Cup Installer, C-4171 Handle.

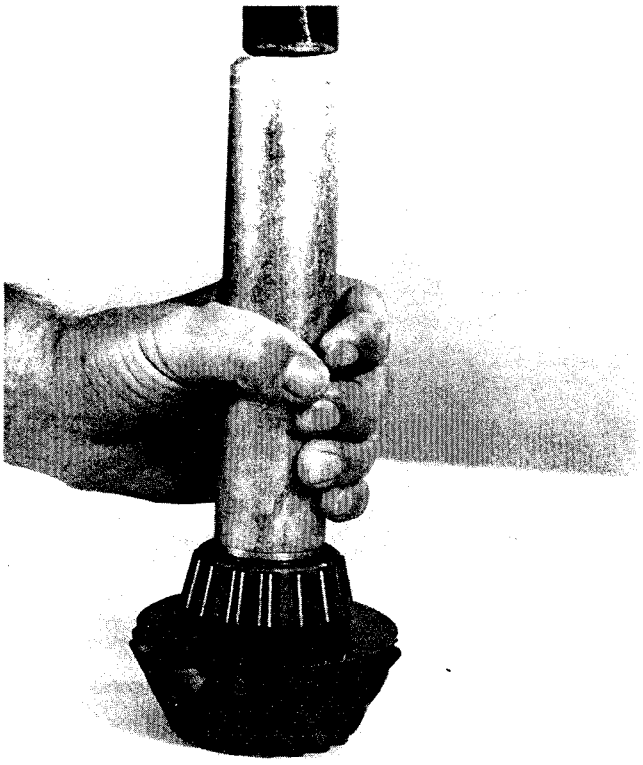


Figure 50 1021-50

Assemble slinger and inner bearing cone on pinion, place bearing installer over pinion stem as shown. Drive bearing on stem until it is completely seated.

Tool—W-262 Installer.

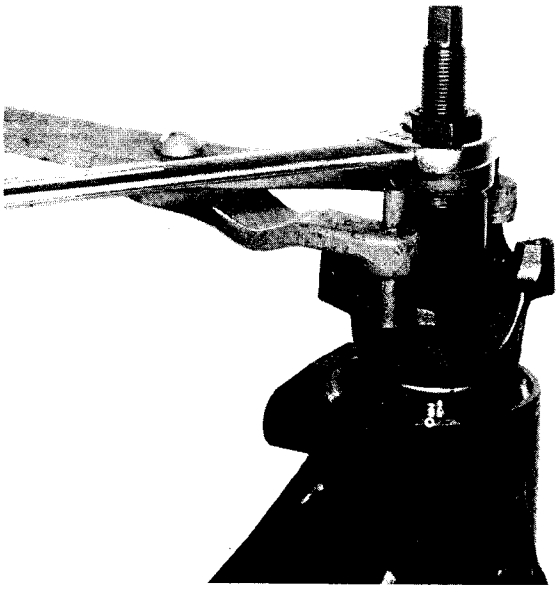


Figure 51 1021-51

Install pinion into carrier.

Assemble outer pinion bearing cone, outer pinion oil slinger, and end yoke onto pinion spline.

NOTE

Do not assemble preload shims or pinion oil seal at this time.

Use yoke installer (as shown) to assemble end yoke onto spline of pinion.

Tool—Installer W-162, Holder C-3281.

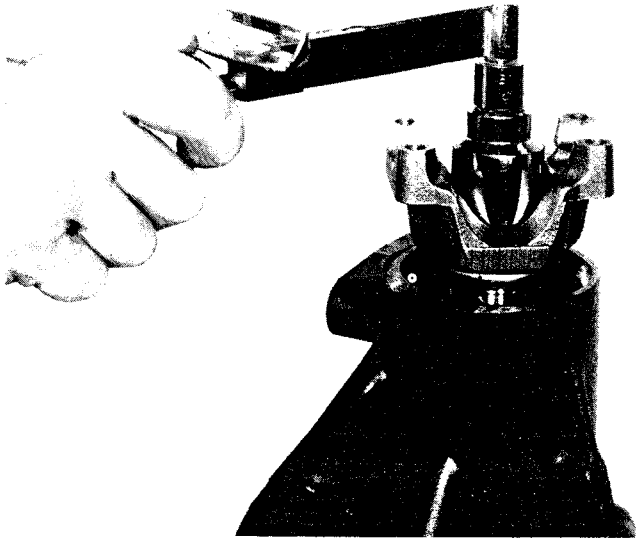


Figure 52 1021-52

Assemble washer and pinion nut. Torque nut until it requires 10 lbs.-in. (1.13 N·m) to rotate pinion. Rotate pinion several times before checking pinion position. This is to seat the bearings and assure a more accurate reading of pinion depth setting.

NOTE

The reason for not assembling preload shims and new pinion oil seal at this time, is due to the possibility of having to adjust pinion preload or pinion adjustment. It would be necessary to again remove the seal, and as mentioned, whenever seals are removed they are to be discarded, because of possible damage.

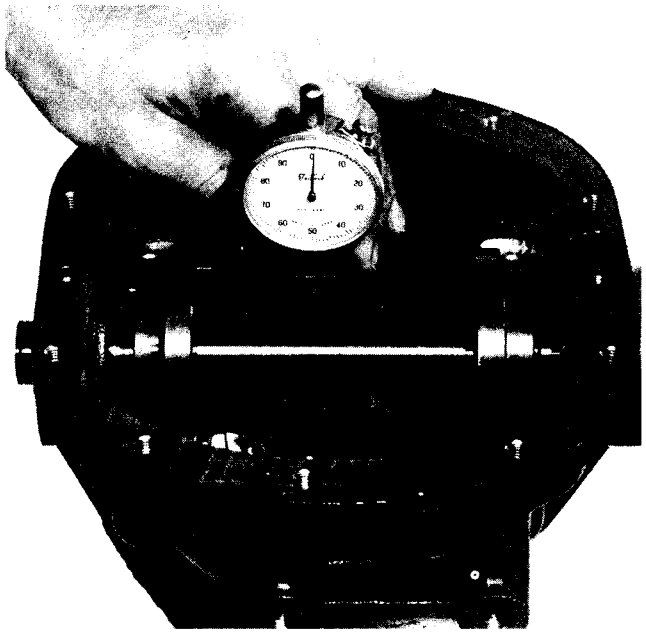


Figure 53 1021-53

Place arbor and arbor discs (small diameter discs for Model 30 axle) into cross bore of carrier. Place pinion height block on button end of pinion. Set dial indicator on zero "0". (Refer to FIGURE 45).

Slide scooter gage across or over arbor.

Indicator will read a plus (+) or minus (-) at its highest point, depending on the etching of the pinion.

NOTE

Indicator reading within .002 (.05mm) of etching is considered acceptable.

If pinion position is found to be within specifications, continue with build up. If pinion position is not within specifications, change shim pack thickness under inner bearing cup.

Insert pinion into carrier.

Assemble preload shims (which were removed during disassembly) onto the pinion.

Assemble bearing cone, slinger, end yoke, washer and pinion nut.

Torque pinion nut to 200-220 lbs. ft. (271-298 N•m).

Tool: Holder C-3281, Torque Wrench C-4053.

Using an inch pound torque wrench rotating torque of pinion should read between 20-40 lbs. inch (2.3-4.5 N•m) with new bearings. If original bearings are used, torque reading should be 10-20 lbs. in. (1.13-2.26 N•m). To increase preload, remove shims, to decrease preload, add shims.

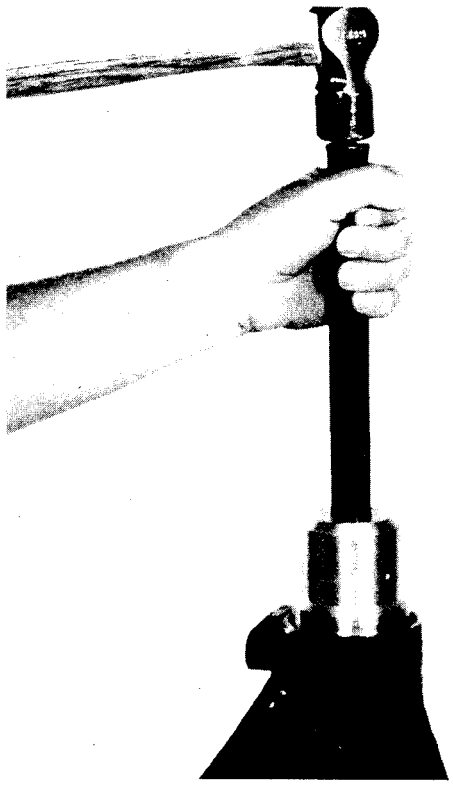


Figure 54 1021-54

If pinion preload is within specifications, remove pinion nut, washer, end yoke and pinion. Assemble new pinion oil seal into housing as shown. Apply a light coat of oil to the lip of oil seal.

Tools—W-147D Seal Installer, C-4171 Handle.

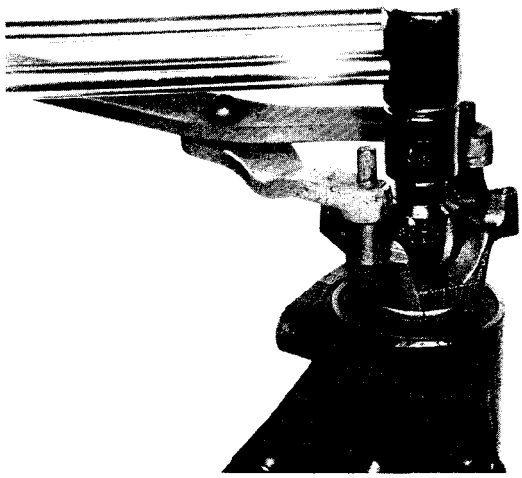


Figure 55 1021-55

Install pinion. Assemble end yoke, washer, and new pinion nut. Torque nut to 200-220 lbs. ft. (271-298 N•m).

Tools—C-3281 Yoke Holder.

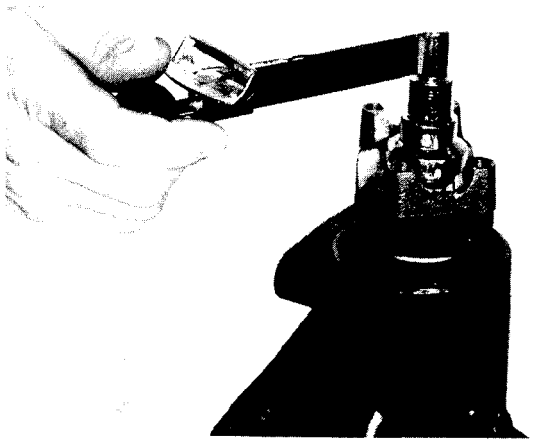


Figure 56 1021-56

Using an inch lb. torque wrench as shown, rotate pinion. Torque of pinion should read between 20-40 lbs. in. (2.3 - 4.5 N•m).

To increase preload, remove shims; to decrease preload, add shims.

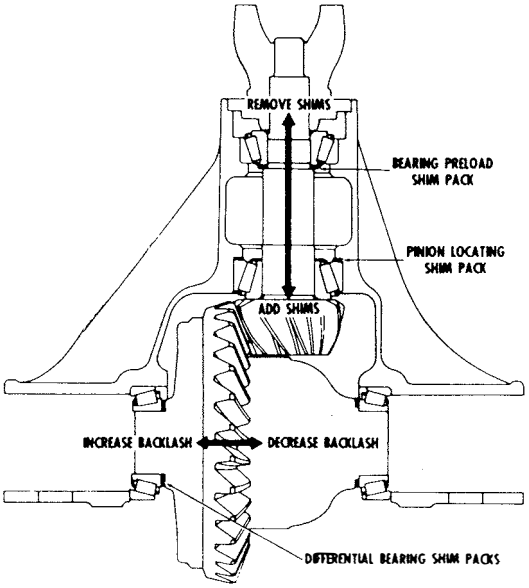


Figure 57 1021-57

The illustration shows the arrow in the pinion pointing in two directions. The direction of the arrow pointing towards the end yoke indicates that by removing pinion locating shims, the distance from the centerline of the axle to pinion button, is increased giving a plus reading. The preload shim pack does not affect the pinion depth setting.

Arrows on the ring gear illustrate the method to increase or decrease backlash, and differential bearing load.

ASSEMBLY OF DIFFERENTIAL

Place differential assembly (with pinion assembled) into housing. Differential master bearings should still be installed to differential case.

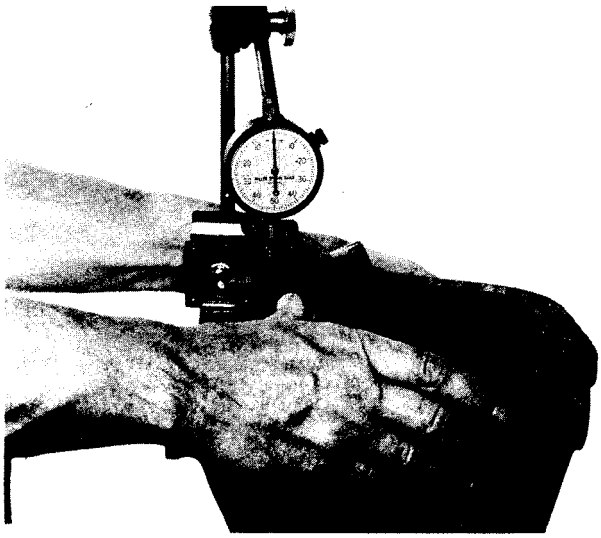


Figure 58 1021-58

Set up dial indicator as shown. Be sure to locate dial indicator on same ring gear screw as shown in FIGURE 36. Force ring gear to mesh with pinion gear. Rock ring gear to allow the teeth of the gears to mesh. With force still applied to the differential case, set indicator at zero "0".

Tool—Indicator D-128.

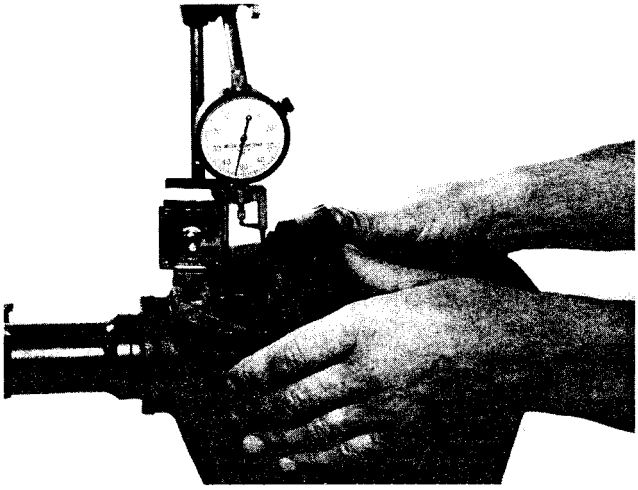


Figure 59 1021-59

Force the differential assembly (ring gear) away from the pinion gear, to obtain an indicator reading. Repeat until the same reading is obtained each time. This reading will be the necessary amount of shims between the differential case and differential bearing on the ring gear side. Remove indicator and differential case from the carrier.

Remove master bearings from differential case.

Figure 60 1021-60

Assemble the required amount of shims onto hub (ring gear side) as determined in FIGURE 59. Place bearing cone on hub of case. Use bearing installer to seat bearing cone as shown. Step plate is used to prevent possible damage to hubs, while assembling bearings.

Tools—Installer C3716-A, Handle C-4171.

Assemble the remaining of the total shim pack which was determined in FIGURE 37 on the opposite side of the differential case. Add an additional .010″ (.25mm) of shims on this side to provide differential bearing preload. Assemble differential bearing using the tools shown.

For example:

In FIGURE 37 (less pinion) a total of .085″ (2.03mm) indicator reading was recorded.

In FIGURE 59 (with pinion) a total of .055″ (1.4mm) indicator reading was recorded. This leaves a balance of .030″ (.76mm) of shims for the opposite side and adds up to the .085″ (2.16mm) which was first recorded.

Add an additional .010″ (.25mm) shims on the opposite side for bearing preload and backlash.

Ring Gear Side .055″ (1.4mm).

Opposite Side .030″ (.76mm) balance plus opposite side preload .010″ (.25mm) for a total of .040″ (1.02mm).

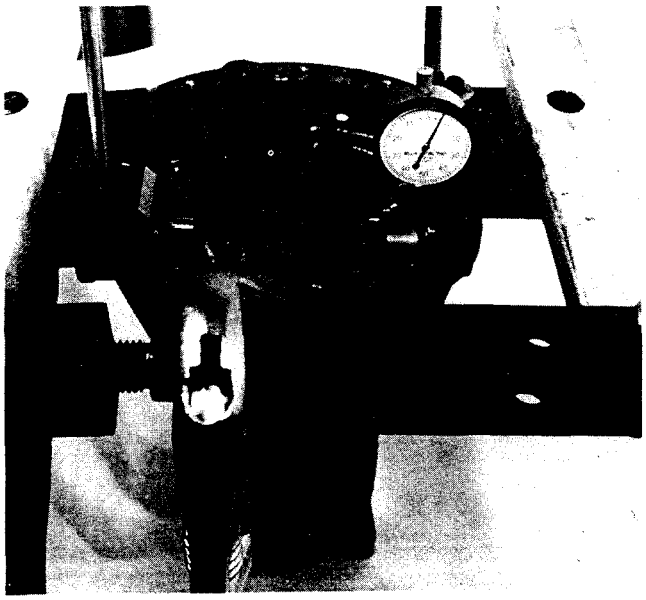


Figure 61 1021-61

Mount spreader with adapter blocks and hold-down screws and indicator to carrier as shown.

Do not spread carrier over .020″ (.50 mm).

After carrier has been spread, remove indicator.

Tools—D-113 Spreader, D-263-1 Adapter Blocks.

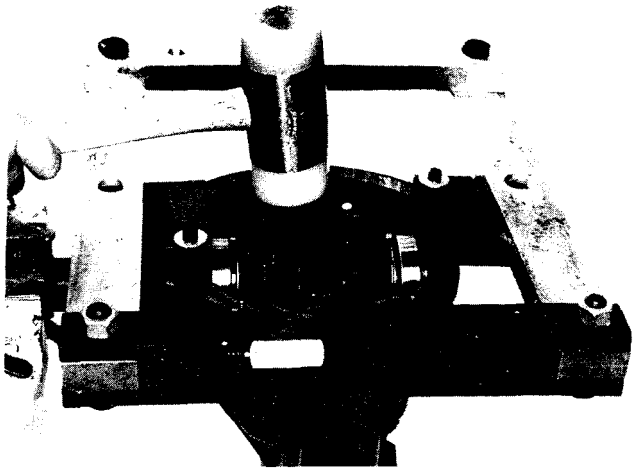


Figure 62 1021-62

Assemble differential bearing cups to differential bearing cones.

Install differential assembly onto carrier.

Use a rawhide hammer to seat differential assembly into cross bore of carrier. Care should be taken to avoid nicking the teeth of the ring gear and pinion during assembly. Remove spreader.

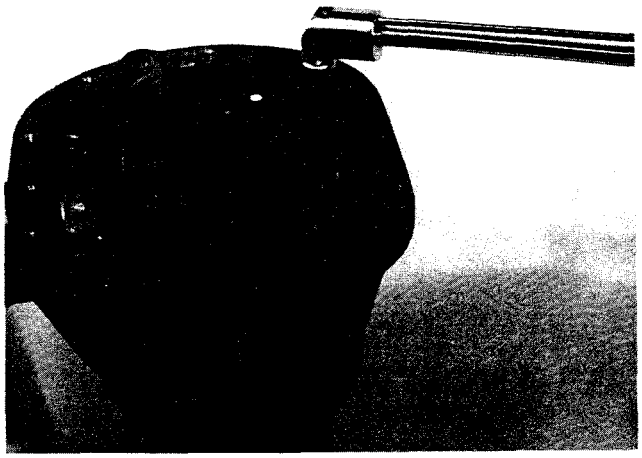


Figure 63 1021-63

Install bearing caps. Make sure the letters stamped on the caps correspond with those on the carrier. Torque bearing cap screws to 35-50 lbs. ft. (47.5 - 67.8 N.m).

Figure 64 1021-64

Check ring gear and pinion backlash in three equally spaced points with dial indicator shown.

Backlash tolerance is .005″ to .009″ (.13 to .20mm) and cannot vary more than .003″ (.75mm) between points checked.

High backlash is corrected by moving the ring gear closer to the pinion.

Low backlash is corrected by moving the ring gear away from the pinion.

These corrections are made by switching shims from one side of the differential case to the other.

Tool—D-128 Indicator.

TOTAL TORQUE TO ROTATE

Use an inch lb. torque wrench as illustrated in FIGURE 56. The total torque to rotate both the pinion and ring gear should read 40 lbs.-in. (4.5 N•m) maximum.

Low torque reading is corrected by adding shims to the side opposite the ring gear.

High torque reading is corrected by removing shims from the side opposite the ring gear.

If it becomes necessary to add or subtract shims for total turning torque, check backlash again to make sure it is within specifications as spelled out in FIGURE 64.

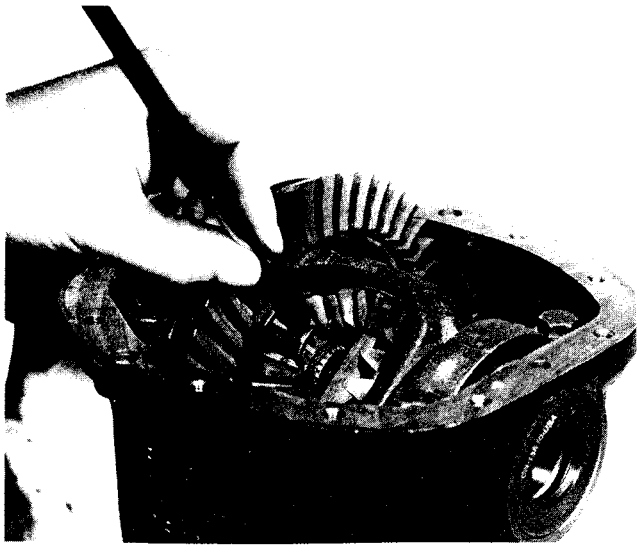


Figure 65 1021-65

Install axle shafts through side gear spline, exposing the snap ring groove inside the differential. Place the snap ring in the groove and force it into place using a blunt screw driver or other suitable tool.

CAUTION

To avoid injury, wear eye protection. If the tool slips, the snap ring may fly out.

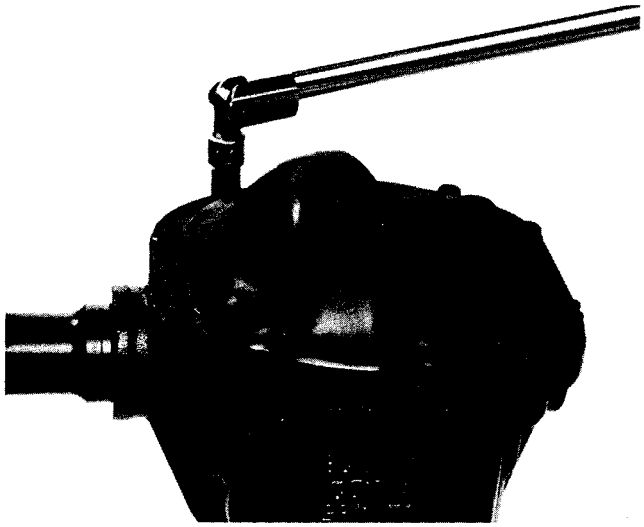


Figure 66 1021-66

Fill the two ½″ diameter manufacturing holes with silicone-type sealant material meeting ASTM3 specification GE303, A19, B37, E16, Z1, Z2 and Z3. Install new cover gasket and cover plate. Torque screws to 30-40 lbs.-ft. (40.7-54.2 N•m).

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RING GEAR & PINION TOOTH PATTERN INTERPRETATION

When setting the pinion position, many of the service manuals required a final pinion position check by using gauges that verified the dimension from the center line of the differential carrier (center line of ring gear) to the face of the pinion (button).

This surface (button) is not used on all new gears for verifying the pinion position. The service tools will be used to establish the proper amount of shims required prior to installing the pinion gear. The final pinion position will be verified by using the GEAR CONTACT PATTERN METHOD, as described in this bulletin.

RING GEAR AND PINION TOOTH CONTACT PATTERN

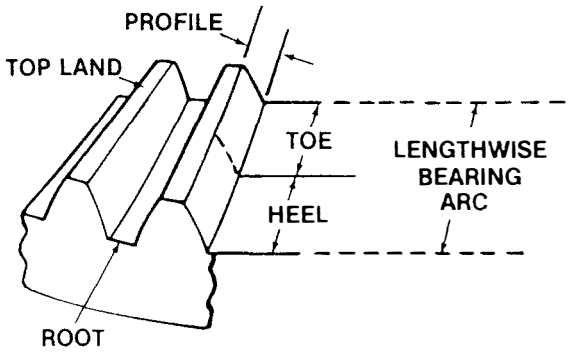

Figure 1 - RING GEAR TOOTH

The TOE of the gear tooth is the portion of the tooth surface at the end towards the center. The HEEL of the gear tooth is the portion of the tooth surface at the outer end. The TOP LAND of a gear tooth is the surface of the top of the tooth. Every gear has a characteristic pattern. The illustrations show typical patterns only, and explains how patterns shift as gear location is changed. When making pinion position changes, shims should be changed in the range of .002 inch (.05 mm) to .004 inch (.10 mm) until correct pattern has been obtained.

When a change in backlash is required, backlash shims should be changed in the range of 1-1/2 times the amount of backlash required to bring the gears into specification. For example, if the backlash needed to be changed by .004 inch (.10 mm), the shim pack should be changed by .006 inch (.15 mm) as a starting point. The actual amount of backlash change obtained will vary depending upon the ratio and gear size.

High backlash is corrected by moving the ring gear closer to the pinion. Low backlash is corrected by moving the ring gear away from the pinion. These corrections are made by switching shims from one side of the differential case to the other.

NOTE

When making changes, note that two variables are involved. Example: If you have the backlash set correctly to specifications and you change the pinion position shim, you may have to readjust the backlash to the correct specification before checking the pattern. Refer to pattern interpretation.

WARNING: Gear teeth may have sharp edges. When handling gears, use care to avoid personal injury.

STEPS

(1) Paint ring gear teeth with a marking compound to both the drive and coast side.
(2) Rotate ring gear one complete revolution in both directions while load is being applied with a large screwdriver or similar tool between the carrier casting and differential case flange.

PATTERN INTERPRETATION (RING GEAR)

DRIVE SIDE HEEL TOE | COAST SIDE TOE HEEL

Normal or desirable pattern. The drive pattern should be centered on the tooth. The coast pattern should be centered on the tooth, but may be slightly toward the toe. There should be some clearance between the pattern and the top of the tooth.

Backlash correct. Thinner pinion position shim required.

Backlash correct. Thicker pinion position shim required.

Pinion position shim correct. Decrease backlash.

Pinion position shim correct. Increase backlash.

PATTERN MOVEMENTS SUMMARIZED

(1) Decreasing backlash moves the ring gear closer to the pinion.
Drive pattern (convex side of gear) moves slightly lower and toward the toe.
Coast pattern (concave side of gear) moves lower and toward the toe.

(2) Increasing backlash moves the ring gear away from the pinion.
Drive pattern moves slightly higher and toward the heel.
Coast pattern moves higher and towards the heel.

(3) Thicker pinion position shim with the backlash constant moves the pinion closer to the ring gear.
Drive pattern moves deeper on the tooth (flank contact) and slightly toward the toe.
Coast pattern moves deeper on the tooth and toward the heel.

(4) Thinner pinion position shim with the backlash constant moves the pinion further from the ring gear.
Drive pattern moves toward the top of the tooth (face contact) and toward the heel.
Coast pattern moves toward the top of the tooth and slightly toward the toe.

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